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STIMulating success: An institutional approach to support for learning in STEM-based disciplines.

Therese Wilson [1], Ian Lightbody [2], Christine Devine [1], Hayley Moody [1], Richard Medland [1], James Brady [1], Sharmila Gamlath[1], Yulin Liu [1], Dulip Herath [1]

[1] Science and Engineering Faculty;[2] Learning and Teaching Unit;
Queensland University of Technology

Abstract

The establishment of Queensland University of Technology's STIMulate program signifies an institutional response to provide integrated and accessible support for learning to enhance student success in maths, science and IT. Drawing on a social justice framework, the program incorporates strategies and experiences to enhance student engagement, access and participation, contributing to the normalisation of help-seeking behaviours. Delivery of the program is distinct in that it brings together peer support by a team of experienced student volunteers and academic support by discipline specialists, complemented by virtual spaces where students can access online learning resources and collaborate with peers. In addition to describing the STIMulate program and its evaluation, this good practice report contextualises the importance of program alignment with institutional goals and collaboration with academic and professional staff across divisional boundaries to enhance visibility and value for all students. The contribution of STIMulate to the learning and success of thousands of QUT students has received national and international acclaim.

Introduction

Our economy has become increasingly reliant on workforce skills in Science, Technology, Engineering and Mathematics (STEM). In 2014, a report of Australia's Chief Scientist claimed that, "International research indicates that 75% of the fastest growing occupations now require STEM skills and knowledge" (Office of the Chief Scientist, 2014). Furthermore, STEM literacy is widely regarded as a prerequisite for reflection, critical thinking and further learning (Zollman, 2012). However, in recent decades, there has been concern by educationalists and policymakers around the world that the study of science and mathematics at school is at dangerously low levels (Kennedy, Lyons, & Quinn, 2014; King & Cattlin, 2014; Lamb & Fullarton, 2002; Schmidt, McKnight, & Raizen, 2007). These trends, in conjunction with higher education's widened participation agenda, highlight the need for the tertiary education sector, and universities in particular, to play a leading role in supporting and guiding diverse student groups to acquire a more comprehensive knowledge of STEM concepts.

However, whether enrolled in STEM-based disciplines such as engineering, physical science or information systems, or other disciplines such as nursing, education, pharmacy, design or dietetics, where STEM concepts and confidence are essential for successful course completion but not perceived as core, many university students need support to enhance their maths, science and IT learning in order to succeed in their studies, and subsequently, in the workplace. Many universities have responded to these needs by establishing specialised learning support arrangements in the STEM area. Learning support centres for mathematics have been common in Australian universities for some time with a 2007 study finding that at least one such centre

existed at that time in 32 of the 39 universities considered (MacGillivray & Wilson, 2008); science learning support needs are more commonly met via course-based programs, while IT support is often the responsibility of the IT Help Desk. Typically these more traditional forms of support are restricted by subject, discipline or perhaps faculty boundaries. Institution-wide academic skills support may include a small numeracy component but these arrangements are primarily focused on providing remedial help for students who are struggling, rather than addressing the needs of average and high achieving students.

STIMulate was launched at QUT early in 2013 to provide a coherent program of drop-in, group and on-line support available to all coursework students, not just those requiring remedial support. STIMulate is: underpinned by a Social Justice Framework (Nelson & Creagh, 2013) that prioritises the rights and self-determination of participants as well as equity and access for all; nested within and aligned to QUT's broader Support-for-Learning Framework that normalises help-seeking behaviour; premised on partnerships with students, professional and academic staff, unit coordinators, divisions and faculties; and administered under the umbrella of visible and accessible academic services. It provides a single, integrated program of maths, science and IT support for all coursework students in all six faculties and across all three campuses; broad and deep, student-centred support from academics and volunteer students; and physical and virtual spaces that build a supportive learning community.

History and funding

Learning support for mathematics began at QUT in 2002 with a faculty-based program funded by a university learning and teaching grant. By 2004, the recognised need for university-wide mathematics and statistics support saw this program extend to the nationally-recognised, institution-wide QUT Maths Access Centre (QUT MAC), jointly funded by the faculty and the Vice-chancellor. From early years, an important component of the QUT MAC was the provision of drop-in support by more advanced students. This model inspired the development of a faculty-based Science Learning Network which supported first year Science students and an IT Duty Tutor scheme which similarly supported students from the then Faculty of Information Technology. These three programs operated independently and were required to annually seek funds to ensure their continuation.

In 2012, funding was procured through QUT disbursement of Student Services Amenities Fee (SSAF) funds, to provide a university-wide support-for-learning program for students who might benefit from support in learning maths, science and IT concepts in their courses. STIMulate consolidated these previously dispersed initiatives into a single program, which, developed a successful profile that was highly visible within and outside the QUT community.

Frameworks

Being SSAF funded, provided the impetus during the establishment of the program, to ensure that as many students as possible had opportunities to benefit from its existence. This gave rise to the adoption of the Social Justice Framework which has informed the ethos, structure and evaluation of STIMulate. Table 1 demonstrates how this framework, which prioritises access, equity, rights and self-determination for all participants, is enacted in the program. A significant implication of the Social Justice Framework is that the program has moved away from the reactionary deficit model, which seeks to fill the gaps for targeted students or units, to an integrated whole-of-institution approach that normalises help-seeking behaviour by acknowledging it as a foundational academic skill of the successful student. This approach is consistent with the Learning Development approach described by Hilsdon (2011) and

implemented across the UK through Centres of Excellence in Teaching and Learning (CETLs). Similar approaches to supporting students to acquire vital academic skills through collaborative partnerships between different parties are also becoming increasingly common in other universities around Australia (Einfalt & Turley, 2013).

Table 1: Enactment of the Social Justice Framework.

Guiding principle		Enactment within STIMulate	Result
Access	All QUT students have access to quality STEM support-for learning.	Available on all campuses for all disciplines explicitly or implicitly requiring STEM skills. (Structure)	Students from diverse educational, cultural and socio-economic backgrounds are equitably supported in their learning so that access to higher education transfers to successful outcomes.
Equity	Access should be provided equitably for groups and individuals.	Monitoring of usage data to ensure student representation is broad and equity groups are included. (Evaluation)	
Rights	Every student has the right to receive the support they need to achieve success.	Ongoing development of welcoming non-judgemental culture. (Ethos and training)	
Self-determination	Every student determines their own definition of success.	Support is available to all students from struggling to high achievers. (Ethos and structure)	

A further framework that underpins the program is the STIMulate program logic model which has been developed based on the Kellogg Foundation's (2004) approach. This model explicates the relationships among program elements, linking objectives to systematic approaches to coordination, implementation, monitoring and evaluation of impact, hence providing a mechanism for demonstrating and evaluating the alignment of program outputs and objectives.

The creation and maintenance of an institution-wide STEM support-for-learning program, is only possible because of an institutional ethos that values support for learning and student success in the broadest possible way. The three programs that preceded STIMulate lacked a champion that could facilitate their embedding at an institutional level. However since its establishment, STIMulate has had strategic direction provided by a cross-faculty advisory committee including: Director Library Services, Associate Director Student Success and Retention, Assistant Deans, Learning and Teaching (or representatives) of the Faculties of Science and Engineering, Health and Education, various Heads of School and Academic Program Directors. This strategic level engagement ensures that the support-for-learning needs identified and met by STIMulate are championed at the highest levels, underlined by a shared understanding of purpose, reflecting the QUT Blueprint (QUT, 2016). As Verity and Trowler (2011) suggest, it is the role of institutional values that sees programs like STIMulate "as the jewel in the learner-centred crown of the university." (p. 243)

Structure

Staffing

Unusual in support-for-learning programs, most STIMulate staff have been appointed to academic positions in schools within the Science and Engineering Faculty, despite the fact that their positions are that of Learning Support Coordinator (or Assistant) within STIMulate. As

well as ensuring that staff have the required discipline knowledge to provide quality support for learning, academic positions provide these staff members with connections in the schools and an increased level of credibility amongst the academics whose students they support. As the program has grown in reach and popularity, academic staff numbers have been increased to meet student need. Academic staffing is supplemented by two full-time professional staff: a Coordinator who manages the strategic direction and liaises with the wider university, faculties, student groups and university-level committees; and a Student Support Officer who supports staff, volunteer students and visiting students, particularly in the dedicated drop-in space.

Complementing the work of STIMulate academics is a large team of volunteer Peer Learning Facilitators (PLFs). Recruited for their academic skills and desire to support their peers, these students are drawn from the range of courses which the program supports. To be considered for a PLF role, students must have completed at least two semesters of full-time study and achieved a GPA of 5.5 or above, with grades of 6 or 7 in the specific subjects they support. Since 2013, 290 PLFs have volunteered over 16,000 hours towards the program. STIMulate's uniqueness partly stems from the fact that rather than helping peers in isolation, PLFs work together with STIMulate staff to address the varied needs of a diverse student body.

Utilising the skills and knowledge of high-achieving students has numerous benefits for all parties involved; it is obviously a cost-effective approach to learning from the university's perspective, it enables the PLFs involved to gain a range of transferrable socio-communicative skills and students seeking help are likely to be more open about their learning needs and challenges with their peers (see Topping, 2005 and references therein). As noted, among others, by Terrion and Leonard (2007) and Ensher, Thomas, and Murphy (2001), such peer learning activities fulfil important psychosocial functions for students facing academic and other challenges, as interacting with empathetic, motivated, high-achieving students similar to them in age and experience can contribute towards student success and retention. Recognition of these benefits associated with peer learning have led to universities investing more resources on such initiatives and incorporating them into their strategic planning efforts.

In the STIMulate program, all PLFs are provided with extensive training to deliver effective learning facilitation and peer-to-peer support, and to further develop their leadership capacity. One-day compulsory training for beginning PLFs incorporates an overview of the program principles and processes ensuring that PLFs fully understand the program and its ethos, as well as skill development in areas such as communication and cultural competence and specific training in one-to-one learning facilitation. Advanced training and professional development opportunities are provided every year for ongoing PLFs. QUT's valuing of peer programs and a desire to ensure the quality of such programs has seen this training incorporated into a university-wide integrated peer training day, supplemented by online training modules.

The use of volunteers has implications for the university under the Fair Work Act. STIMulate is able to ensure these requirements are met through adherence to QUT's peer programs strategy and a close working relationship with coordinators of that strategy. In addition to training, a volunteer agreement and structured reward and recognition contribute towards safeguarding PLFs and the program (Menzies, Tredinnick, & Van Ryt, 2015).

Consistent with the Social Justice framework, the PLFs are a self-determining body from which an emergent leadership arose in the first semester of operation. Roles within this team have transitioned to the award winning STIMulate Student Executive which partners with staff to ensure the needs of PLFs are met. Many PLFs embrace leadership opportunities and the program is linked to the QUT Leadership, Development and Innovation Program for students,

which provides accreditation and links into a wide range of opportunities such as the Peer Programs Student Advisory Committee. Without this team of volunteers, the program would be unable to provide the amount and breadth of support that it does. To ensure the buy-in of students in this role, it is important to understand what motivates these volunteers. This is a topic of ongoing research by the staff of STIMulate. It is known that for beginning PLFs, the most likely factors of motivation can be clustered as relationships and experiences; more specifically, PLFs are motivated to learn through their experience, develop their capabilities and strengths and build positive relationships with other students. (Devine et al., 2016)

Program delivery

STIMulate provides a blended model constituting one-to-one drop-in support with peers, one-to-one booked appointments, group sessions, and on-line learning resources and interactions with staff. The flexibility provided by this model allows the program to meet diverse student needs. Figure 1 illustrates a variety of experiences that are likely to occur in any one semester. While economic pressures and human resource constraints are forcing many university support programs to discontinue one-to-one sessions, for some students, especially those who lack confidence or successful experience with the university system, these interactions are a crucial mechanism to facilitate their academic success (Turner, 2011). The STIMulate model is able to maximise the availability of one-to-one interactions through utilising peer-to-peer support in the majority of cases, and expert academic staff support in more specialised cases.

STIMulate maintains a community Blackboard page which houses all its resources and timetables. This page is linked through many unit Blackboard pages. The program also maintains two Facebook pages – a public page for promotion and a private PLF group used for informal communication amongst PLFs and staff. Students will not generally ask specific academic questions through Facebook but will often use the private message mechanism to ask how to get help with a particular problem. The Student Support Officer monitors this page and directs students to PLF drop-in or the most appropriate academic staff member. The PLF Facebook group acts to improve communication and build community amongst PLFs.

At an operational level, STIMulate supports student learning through a cohesive and systematic approach to mapping curricula. Each semester, through unit outlines, usage data and valuable PLF insights, the academic teams in the maths, science and IT streams develop coherent plans of the units on offer with high STEM requirements. These plans map content and assessment over the semester together with support resources, including personnel (staff and PLFs), group sessions and other resources. Regular stream newsletters and team meetings ensure that these plans are shared among all staff and PLFs. This planned information sharing is frequently supplemented by timely social media communication from PLFs such as: *If anyone comes in looking for help with …, I would suggest directing them to …*

Given the ubiquitously acknowledged fact that assessment drives learning, it is of no surprise that student attendance at the drop-in space increases dramatically when assessment is due. This results in increased pressure on even highly experienced PLFs. At the end of our first year of operation, we identified that this pressure was increased further by uncertainty regarding the level of assistance to provide with assessment items and by mismatched expectations between teaching academics, students and PLFs. In response to this, we developed the STIMulate Traffic Light System for Assessment. Through this system we contact Unit Coordinators for advice on the level of assistance they would like us to provide for each assessment piece: Green, facilitated learning, Amber, limited assistance, or Red, no assistance. This structure clarifies expectations for all parties, and provides PLFs with a mechanism for tactfully refusing to

accommodate the expectations of certain demanding students. PLFs are trained in this system and regular updates regarding current assessment items are provided.

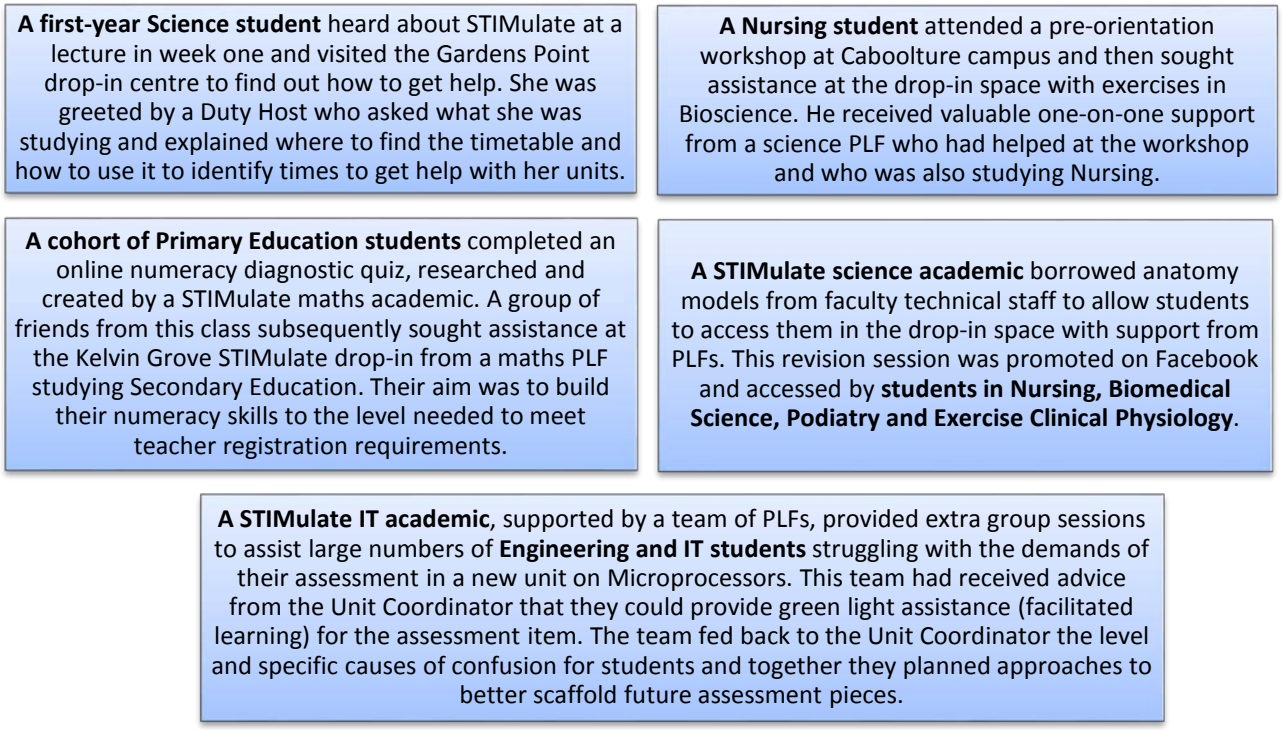

Figure 1: A sample of typical student experiences with STIMulate.

As STIMulate has grown, delivery of a coherent and efficient program has required the automation of a number of systems. For example at the end of 2013, QUT IT services developed a system that links into official student information to log participation of students and PLFs. The introduction of this system in 2014 made the experience of students more seamless and the task of PLFs simpler. This significantly improved the accuracy and completeness of participation data, and consequently the ability to monitor support-for-learning needs and provide feedback to teaching academics and Course Coordinators. Another example is the PLF rostering system. In earlier years, each semester would commence with staff needing to manually schedule the drop-in hours of PLFs across the week and publish static timetables in physical and virtual spaces. Whenever a PLF was unavailable, this information needed to be conveyed to visiting students. An interacted web-based solution has now been created by an IT PLF graduate. This system allows PLFs to nominate their preferred hours and areas of expertise; an optimal timetable is created and made available online; during semester, PLFs can indicate absences and a real-time schedule is available online.

Evaluation

Program development and improvements are based on regular rigorous evaluation. Quantitative participation data are used to demonstrate student engagement, to adjust schedules to meet demand and to provide feedback to unit coordinators regarding support needs. Qualitative data are also collected both routinely and for special projects. Every visiting student is able to comment on the service they received using the online registration. PLFs find these comments, which are invariably positive, highly motivating for their ongoing contributions. From 2013 to 2015 a Snapshot Survey was administered each semester to every student

participating in face-to-face mode during Week 7. Responses were elicited from 1211 students over six semesters with close to 100% response rate. The two questions: “Was your session with STIMulate useful?” and “Would you use STIMulate again?” received extremely positive results with an agreement level of at least 94% each semester. To probe more deeply in 2014, an online survey was administered to all students undertaking courses regularly supported by the program. The survey provided insights into areas for improvement and enabled identification of reasons students gave for not seeking support (Moody, Wilson, Devine, Medland, & Lightbody, 2015). Two major enhancements that were implemented in response to this feedback are the introduction of a STIMulate Student Support Officer to improve the experience of visiting students and an increase in the role of PLFs in promoting the program.

A project undertaken by the Equity Services Team in 2015 provided an online reporting tool to assist in monitoring engagement with equity groups across the university. At present this tool only reports on drop-in data from the program with no inclusion of group or virtual support. Table 2 illustrates the proportion of STIMulate drop-in students in 2016 falling within targeted equity groups and compares this with the proportion of QUT students falling in these groups. The data illustrate that the program is successful in reaching students within these groups.

Impact

The primary indication of the impact of the program is the number of students utilising its services and the level of engagement from the volunteers. During 2016, there were 3,651 drop-in visits and 2,970 visits to group support session, while a total of 169 student volunteers recorded 4,246 hours of support for their peers through the program. In an era when student attendance at regular classes is routinely low, engagement with optional ‘extra-curricular’ support is a clear indication that students value the program (MacGillivray & Croft, 2010).

Table 2: Comparison of equity groups accessing STIMulate drop-in with QUT profiles during 2016.

Equity group	STIMulate Drop-in support	QUT profile
Low SES students	17.8%	13.4%
Regional and remote students	12.0%	9.8%
Students with a disability	5.8%	4.3%
Aboriginal and/or Torres Strait Islander students	1%	1.7%
Non-English speaking background students	6.9%	3.1%
Women in non-traditional areas	19.6%	18.4%

Through ongoing evaluation, significant benefits have been identified: (i) academic success and confidence for participating students; (ii) transferable skills and attributes for PLFs; and (iii) enhanced curriculum development and teaching for the broader student population as a response to the feedback provided through STIMulate to the academic community.

Academic success and confidence

In an anonymous online 2014 survey, 80% of respondents who had used the program indicated it had been helpful or very helpful with the maths, science and/or IT demands of their course, and 80% reported that it had a helpful or very helpful impact on their confidence with their

studies. For some of these students, this influence was critical to them continuing with study; 30% indicated that they had considered dropping out of their course because they were having difficulties with maths, science or IT skills or concepts and of these, 41% reported that STIMulate had directly influenced their decision not to do so. As one student expressed this:

> I seriously considered dropping last Semester. It really helped to sit down with people doing the course and chat about the course and the concepts.

The STIMulate Centre on QUT's main campus exemplifies the inclusive learning community that has been created on the foundation of close working relationships among staff, volunteers and students. Students are able to socialise, study and assist each other in the informal area adjoining the drop-in space. Consistent with the self-determination aspect of the Social Justice framework, PLFs have been largely responsible for the organisation of this space. Their ideas for a space redesign were facilitated by advocacy from STIMulate staff which resulted in the university providing $90,000 for furniture in recognition of the value to student learning that this space has become. Very productive learning occurs there, but equally importantly, students develop a sense of belonging to their discipline that contributes to an increase in confidence.

Transferable skills and attributes for PLFs

STIMulate PLFs are volunteers who receive no academic credit for their work. Their motivations are complex (Devine et al., 2016): some volunteer because they understand the valuable contribution they are making to individuals and society; some have previously received support themselves and this is their way to 'pay back'; many thrive in the learning community, mixing with like-minded peers to foster friendships and benefit from this learning network; others benefit from additional opportunities of leadership, training, experiences and the mentoring provided by experienced PLFs and staff. Involvement as PLFs builds graduate capabilities and for many this serves as a launch pad to future achievements. Often PLFs move on to academic roles such as sessional tutoring and graduate with distinction and University Medals and, in one case, as a 2015 Rhodes Scholar. Another PLF who has been a team member from the first semester to the present, described the benefits as follows:

> I joined STIMulate when it first started in 2013, because I wanted to be a part of QUT's volunteer community. But it's become so much more than that. The training, mentoring by staff, leadership opportunities as a member of the STIMulate student executive team, and most importantly, practising as a PLF have had a huge impact on the development of my professional identity both in IT and in academia. (Louis Van Dyke, PLF 2013-present, Testimonial, 2016)

The multi-disciplinary nature of STIMulate affords PLFs access to a diverse network of peers and academics from which exciting opportunities flow. For example, multi-disciplinary teams of PLFs have been involved in acclaimed humanitarian projects in Colombia, where they mapped an underground gold mining operation and surface water courses, measured contaminants in the water and tested a filtration system for the benefit of the local community, and in Fiji where they provided wireless access and educational resources for remote schools.

Enhanced curriculum development and teaching

The close working relationship between the STIMulate team and faculty academics has resulted in enhanced curriculum development and course delivery, extending STIMulate's influence on the student experience beyond that of direct participants in the program. Through working on the frontline the team has 'a finger on the pulse' of student learning in maths, science and IT, enabling it to provide feedback to faculty staff as issues arise. This has been

particularly valuable during roll-outs of new courses to large cohorts. In some areas, STIMulate staff have worked closely with individual academics to embed materials that motivate students to identify the gaps in their content knowledge, and to access the support they need. At the course level, staff members' experience and expertise in supporting students has resulted in them being invited to provide input into teaching and learning committees.

Conclusion

The increasing reliance on a STEM-based economy continues to underscore the need for university graduates to be literate, competent and confident in these areas. However, diversity of student intake and ongoing concerns regarding the preparation of students completing high-school, implies that most universities are likely to continue to need to implement effective and efficient STEM support-for-learning programs for large numbers of students. For any institution, programs exist within a specific context. The fact that these contexts contribute towards what makes a program successful or not, means that it is generally inappropriate to nominate a specific approach as "best practice". However, that should not prevent the consideration of what aspects of a model constitute "good practice" and the STIMulate model is presented here with that intent.

In establishing a new program of support or evaluating an existing program, it is valuable to consider the frameworks that underpin the program. Programs that develop organically, especially on a small scale, may require a framework to be "retro-fitted". The value that a framework brings is to ensure purpose and cohesion. In the case of STIMulate, the social justice framework has ensured that a student focus directs all decisions regarding program operation. To ensure that a program is valued and supported within a university at the highest level, the program framework should be aligned with institutional teaching and learning frameworks and consistent with institutional objectives. This approach will most likely ensure consistency of funding and program visibility across the institution. It will also provide opportunities for program staff to be appropriately rewarded and recognised for their work. Together, these advantages are likely to increase the impact of the program.

Programs need to be monitored and evaluated from both quantitative and qualitative perspectives. Engagement with the program and improved outcomes for groups of students are valuable measures of impact, but so too are individual student stories. It is important to include methods that evaluate whether actions and outcomes are well-aligned with program frameworks. The program logic model has provided a mechanism for this evaluation in the case of STIMulate.

The success of the STIMulate program in supporting student learning in STEM has been recognised with individual and team awards at the university, national and international level. It is presented here as a model for good practice.

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